SCIENCE.—SUPPLEMENT.

FRIDAY, DECEMBER 4, 1885.

ELECTIVE STUDIES AT HARVARD.[1]

A NEW departure has been made in Harvard college during the past year, in that, for the first time in its history, freshmen have been allowed to choose a majority of their studies. Under the new rules but seven-sixteenths of the work of the freshman year will be prescribed: the rest of the college course, excepting a few exercises in English composition, will be elective.

Let us examine on what facts the Harvard faculty build their confidence in the elective system; in what sense it can be called a system; whether, furthermore, its introduction, while making instruction more agreeable, does not tend to lower its standard; and, last, whether its tendency is to foster character, and to make vigorous and law-revering men.

A preliminary objection is that the so-called system is really no system at all, but a mere cutting of straps. This is a misconception. The student under it merely chooses the specific topic of his study: what the amount of it shall be, and what its grade of excellence, are decided for him. After completing his freshman year, the Harvard student must pass successfully four elective courses in each of the following three years; and in each course or single line of study 50 per cent of a maximum mark are required each year for a pass. After his first year, then, the Harvard B.A. must have prosecuted twelve courses of self-selected studies, and mastered them at least half perfectly.

The essence, then, of the elective system, is fixed quantity and quality of study, but variable topic. Every important New England college admits it, to a certain extent, in both senior and junior years, while some allow it in the sophomore. In Harvard its adoption has been very gradual. In 1825 options were first allowed in modern languages. Years of experiment followed, with the result that the old method was step by step abandoned. The time of transition has been one of great prosperity. During the past fifteen years the gifts to the university have averaged $250,000 a year, and the number of students has steadily increased; the average attendance of undergraduates during the five-year period 1861 to 1865 amounting to only 423, while that during 1881 to 1885 reached a total of 873.

Harvard, then, has become prosperous by taking the lead in a great educational movement, the necessity for which lay in the fact that of late years the field of knowledge has so greatly widened. A place on the college curriculum has had to be found for modern languages, political economy, and science in its various departments. To avoid the danger of superficiality, — which is opposed to thorough-going discipline and the acquirement of sound mental habits of thought, — a choice was necessary between so many different subjects. In making this, too, personal aptitudes had to be considered, and thus a new principle was introduced; viz., that of valuing studies less according to their subject-matter than according to their fitness for the mind of the student. The will came to be treated as of primary importance. The student is told at Harvard, 'Study what you will, but you must will to study something.' The boy is thus taught how to choose during the formative period of his life, that is, between the ages of eighteen and twenty-two.

A manlier type of character is actually observed as the elective principle extends. The students show an enthusiasm for their work that was lacking formerly. Their ideal of a 'gentleman' is now higher than it was; and hazing, window-smashing, and disturbing a lecture-room, are now things of the past. That a decent scholarship has now become reputable, may be seen from the fact that in the last senior year 91 out of 191 men received 'honorable mention;' i.e., took a high rank in three or more courses of a single department. The following table, which gives the average percentage of marks attained at examinations during the past ten years shows that the standard of good scholarship has been steadily rising.

Year.	1874-75	1875-76	1876-77	1877-78	1878-79	1879-80	1880-81	1881-82	1882-83	1883-84
Freshman.....	59	55	5	56	62	62	65	67	64	63
Sophomore....	5	64	63	65	67	68	70	69	69	68
Junior.....	67	65	66	67	70	68	72	75	72	72
Senior.....	67	70	70	73	76	73	77	75	79	81

Observe that the marks become higher on approaching the senior years, where the elective principle most prevails, and that while, in 1874, one-half of the freshmen who were doomed to

[1] Abstract of Professor Palmer's article on Elective studies at Harvard university, *Andover review*.

prescribed studies gained less than 60 per cent, ten years later one-half of the seniors obtained four-fifths of a perfect mark in four electives.

Two objections may here be raised; viz., that the selected courses will have but little connection with each other, and that the easiest ones will always be the favorites. An answer to the first objection is contained in the fact that nearly one-half of the last senior class chose at least three closely related courses. The charge of 'soft' courses is the stock objection to the elective system, and seems, *a priori*, a sound one. The subjoined list of the courses which in 1883–84 were most largely attended by seniors and juniors, shows that, when choice gets full play, the factor of interest may make a severe study popular.

The courses were: Mill's political economy, 125 seniors and juniors; later European history, 102; history of ancient art, 80; comparative zoölogy, 58; political and constitutional history of the United States, 56; psychology, 52; geology, 47; constitutional government of England and the United States, 45. Are not these studies just those which should be the most popular?

It may be asked how such wise selections are secured, and we answer, simply by making them deliberate. In June the students must choose their studies for the next year, and notify the dean of their choice. Until Sept. 21, any elective may be changed, on notice sent to the dean. During the first ten days of the term no changes are allowed, but afterwards for a short time they are easily effected. For the remainder of the year no change is possible, except for urgent reasons.

By these means the faculty tries to avoid waste of time over unprofitable studies. Of course, not seldom unwise choices are made; but is not that true to an even greater extent in the case of prescribed studies? Moreover, the wastes of prescription affect chiefly the energetic and original students, while under the elective system it is especially the shiftless and dull who suffer, that is, men who cannot be much harmed by any system.

Then, how much the instruction under the two systems differs! When studies are prescribed, the teaching becomes often a secondary affair, and the pupils have to be urged to work. Under the elective system the student feels that he has something at stake, and a higher style of teaching becomes possible. Theses are read, and original works consulted. During 1860–61 only 56 per cent of the Harvard undergraduates consulted the college library; during 1883–84, 85 per cent.

Then, again, under the new system at Harvard, attendance at lectures is not compulsory; though, of course, a lengthened absence would not be permitted. The results obtained from trusting the students have been satisfactory. In the last senior class the total absences, whether from sickness, misdeeds, or other causes, amounted to but 16 per cent of the total number of recitations. Colleges requiring attendance seldom show better results.

But when studies are elective, professors are benefited equally with students. Teacher and taught are brought closer together, a common sympathy animating both alike. The professor, too, gets to see himself as others see him, and, if inefficient, his class soon dwindles away. Both professors and students are, in fact, put on their good behavior.

But why introduce the elective system so early as the freshman year? First, because the youth of eighteen needs just such a happy influence on his character as the system gives; second, because the loss of time incident to learning to choose can best be borne in the earlier, that is, least valuable, college years; while, last, the change from school to character methods is too important to be marked by the mere passage from one class to another. A change of residence should mark it. A character-college, then, while no place for the indolent rich, is best suited for the democratic many, to whom the elective system gives an opportunity for mental and moral expansion which no compulsory system can afford.

We must, however, remind the reader that the system is not yet perfected, and has still many imperfections. Convinced, as we are, of the soundness of its method, we invite criticism, which should now turn to the important work of bettering its details of operation.

ENSILAGE IN ENGLAND.

In a return to the house of commons, entitled 'Ensilage commission, evidence, part i., Preliminary report and minutes of evidence,' and in a 'Return of the replies to questions relating to silos and ensilage put by the agricultural department, privy council,' which have lately reached us, the latest information is contained in regard to the views held in Great Britain as to the value of silos and ensilage, and the practical successes and experiences with this still somewhat experimental method of preserving and feeding various kinds of green food to stock, in an undried condition.

The evidence obtained voluntarily by the parliamentary commission from thirty-eight witnesses, including Sir John B. Lawes, Viscount De Chezelles, and the owners and occupants of many large estates, their agents and tenants, and the inventors of different forms of silos, not excluding

any testimony of an unfavorable nature, but endeavoring to induce persons believed to be opposed to the system to give their opinion, has in their opinion, without exception, established the claims of the system to a considerable amount of success; and, although in some cases the results have been evidently more satisfactory than in others, nevertheless, all the systems seem to show that a nourishing, useful food for animals can be preserved, independently of any drying process, within wide lines of divergence in the details of the methods adopted. Different degrees of weighting and of exclusion of atmospheric air are the causes of different degrees of heat, and of consequent chemical change produced. It is apparently, as yet, largely a matter of opinion whether such chemical changes increase or diminish the feeding value of the ensilage, or its relative value in comparison to the green crop. The solution of this question the commissioners naturally regard as of great importance, and consider that careful feeding experiments, conducted with a view to test the exact effect of these changes, are very desirable. They find that whether the ensilage has been covered in immediately after cutting, or put in at intervals, the air not being immediately excluded and considerable heat developed, yet in both cases a useful feeding material has been obtained which would have been lost if any attempt had been made to convert it to hay in unfavorable weather.

As to the economy of different systems of making and storing ensilage, the commission is not prepared to express an opinion; nor does it desire at present to compare the advantages of different systems, the quality of the ensilage being not materially affected thereby. Special circumstances affecting particular localities must influence and regulate the methods employed. It was found that some of the best ensilage was produced with a pressure of not more than seventy pounds per square foot, but the degree to which weighting is necessary or desirable remains to be decided. Good results are claimed with weights between seven and three hundred pounds. Evidence shows that all differences in actual results, not dependent on composition of food-plants employed, are traceable to the variations in the degree to which fermentation is allowed to be set up in the silo, and the length of time it is continued. The fermentation, too, is controlled by or dependent on the manner of constructing, filling, covering, and weighting.

The testimony of the dairy farmers does not appear to justify the assertion, which has been more or less circulated, that dairy products are affected by ensilage; on the contrary, there is much valuable evidence to show that well-made ensilage distinctly improves the yield of milk and cream, and the quality of the butter. This is of interest on this side of the water, as a similar report has gained ground here, without, as far as has been learned from our investigations, any reason, unless the ensilage is fed too soon after coming from the silo. It should be exposed, at least in the case of sour maize ensilage, for a period of twenty-four hours to remove an odor which sometimes affects the milk when the feed is fresh. Tainting of the milk, the commission considers to have been due in many cases to proximity to strong-smelling ensilage after milking. The report concludes by saying that they have heard sufficient evidence to warrant the extension and development of the system as a valuable auxiliary to the farm.

The second part of the report of the commission, soon to appear, will contain the documentary evidence obtained in answer to twenty-five practical questions sent to the proprietors of silos in various parts of the kingdom. We have before us the answers to similar questions sent out by the agricultural department, privy council, which have been published in the second report which has been alluded to, in much the same way as was done by the U. S. department of agriculture two years ago. From the summary of the replies, we learn that the silos in Great Britain have doubled in number in the space of twelve months, that they vary in capacity from 96 to 55,440 cubic feet, averaging 2,801, and that they are built both with and without provision for drainage, but largely without. Drainage, it is suggested, requires care to prevent admission of air, and, we would add, loss of nutrients when the pressure is not properly regulated. The construction of the silos varies in material and location according to the locality where they are built. Any material furnishing the absolute requisite of rendering the walls air-tight seems suitable and successful, and localities where there is sufficient difference to enable the filling to be done at one level, and the drawing-out at a lower one, seem to be most favorable. Oats, green barley and wheat, maize, buckwheat, sanfoin, rye and all sorts of grasses, hop-vine, turnip tops, peas and beans, with mowings from hedges, and fences, and ditches, including nettles, sedges, and rushes, have all been more or less successfully made into palatable ensilage. The addition of salt was mentioned unfavorably in many reports, as was the case with the testimony before the parliamentary commission. The methods of compression have varied very much, but dead weight has been largely employed, and water-tanks so arranged as to be air-

tight covers have been successful in some cases. Opinion seems to be in favor of some simple method of lever pressure as economizing labor. Replies as to the influence of the weather, or temperature and moisture, show that success has been met with in both wet and dry weather, but that there should be no long exposure to the sun after being cut. Young crops make the best ensilage, and attention should therefore be paid to the condition of maturity. The temperature in various silos has been found to vary from no perceptible increase in heat to 150° F.; and according to the temperature at which fermentation goes on, sour or sweet ensilage is produced. A certain amount of exposure before closing the silo seems to have been most satisfactory. In some instances the silos have been opened and refilled as often as became expedient, the period extending over several weeks. At other times they have been filled and closed at once, with not entirely satisfactory results, as it has given a very sour ensilage, with strong odor, when the crop was put in wet; but in other cases the results from grass packed when perfectly wet have been altogether encouraging, even from mere earth-pits. As regards cost, it is stated that on the whole, as far as present experience enables one to form a judgment, the cost of making ensilage is less than that of making hay, more especially when wet weather prevails. Of 164 recorded opinions 72 make the cost of ensilage less than that of hay when it is made in fine weather, while 72 make it about equal, and 20 state that hay-making is cheaper. Deterioration from moulding was generally found for a few inches, but even when there was much deterioration, apparently, and the ensilage was sour and unpalatable, exposure for a few hours was all that was necessary to make stock eat it eagerly. Injury of this description is attributed to loose packing near the walls, and to leaks admitting air at doorways. Cases are rare where deterioration led to discouragement.

The results of feeding stock upon ensilage, especially dairy cows, and its effect on the quality and quantity of milk, the report states as follows:—

"It is often said to be preferred to all other fodder by dairy stock, as well as by horses, and to be less costly than the usual food. A marked increase in the quantity, and improvement in the quality, of milk and butter, appear generally, and accompany the change from dry fodder to ensilage as part of the regular food, and, when used with cake and meal, there is occasional mention of decided advance in condition. Cows appear, however, in a few instances, to have been fed entirely on ensilage for some months with good results, and it is added in numerous returns that more stock can be kept in winter upon land by the use of ensilage, while it is an excellent and economical substitute for roots.

"The recorded opinions of those who have tested its effects in regard to milk and butter assume the following proportions:—

	Milk.	Butter.
No change	22	1
Improved in quantity and quality	95	18
Decreased quantity and deteriorated quality	1	—
Increased quantity	98	13
Decreased quantity	5	2
Improved quality	84	26
Deteriorated quality	5	3
Improved quality and decreased quantity	4	—
Increased quantity and deteriorated quality	5	—
Favorable results (whether in quantity or quality not stated)	30	15
Unfavorable results (similarly not stated)	—	1
Total opinions	294	79

"Disagreeable smell and taste are occasionally referred to as having been present in both milk and butter, which often disappeared upon reduction of the quantity of ensilage given. With reference to this objection, it is recommended that, in feeding dairy cows with ensilage, much of it should not be near them during milking hours, and that persons so employed with it should wash their hands before milking. Ensilage is spoken of generally as a most wholesome and nutritious food for cows, and other stock are said to thrive upon it, especially when given in quantities of about half ensilage in combination with hay and other usual food. The superiority of sweet ensilage is often remarked upon, though a great many are in favor of the sour kind.

"Gain in weight is mentioned as having been tested, while loss of condition, and with cows, diminished quantity of milk, have been noticed after the ensilage made was all disposed of.

"There are but few statements which qualify the records in these respects, and further experience will doubtless do much to remedy the disappointment occasionally expressed in regard to first experiments."

As to the manner of feeding ensilage, the report shows that it is not often used exclusively, but combined with hay, meal, or other rich food, which gives better results. The quantity of ensilage has varied from seven pounds per day, to as much as the animals would eat. The average may be considered as from twenty-five to fifty pounds, according to the age of the animal, when other food is mixed with it. The combinations of food are most varied, and many interesting experiments are given, showing a larger yield of milk on an ensilage diet than on others of mixed materials. The almost unanimous testimony of the report is favorable as to the effect on the health of stock, while in some cases the praise of its value is unstinted.

The replies to the inquiry whether ensilage had been successfully made without a silo, seem to show that it has not frequently been done. Now and then it was made in stacks above ground, or in casks, but with much waste.

The conclusion expressed in the introduction to the report ends by affirming that, of the importance of ensilage as an auxiliary to other food for animals, whether for dairy, store, or young stock, among cattle as well as other kinds of stock,

there can now be scarcely any doubt, if the sum of the aggregate result of the replies recorded may be taken as a guide. The system hitherto may be said to have been somewhat tentative; but, if the rate of development shown in the past year continue, it appears probable that it will be far-reaching in its effect.

The system is undoubtedly peculiarly adapted to the moist climate of England; and the success there met with, in connection with past experience of a somewhat longer and wider range in this country, certainly points to a future which will make this method of feeding stock of the greatest value to the stock and dairy farmer. The evidence of the British farmer is of particular interest, in regard to a new system of this sort, as, from his habits of intensive farming, he is perhaps more qualified to judge of it than his American fellow-laborer.

THE PANAMA CANAL.

THERE is no engineering enterprise now in progress which has excited more general interest, or the successful completion of which will affect more deeply the concerns of the commercial nations of the world than the Panama canal. As work was begun in 1880, or perhaps more accurately in 1881, and as the complétion of the undertaking was promised for 1888, it is quite time to inquire what progress has been made up to the present date, and what is the prospect for the future. The book of Mr. J. C. Rodrigues,[1] which is a reprint of a series of articles written for the London *Financial news*, gives a summary of the operations from the beginning until now, with his opinion of the condition of the company, the political bearing of enterprise as regards the United States, and the impending catastrophe. It deserves a careful perusal by every thoughtful citizen, and presents a more concise, and at the same time comprehensive statement of the case than has as yet appeared.

After a brief survey of preceding explorations of the isthmus, he gives an account of the expeditions of Commander Lucien Napoleon Bonaparte Wyse, of the French navy, and of the concession he obtained from the United States of Columbia, in 1878, for a canal at the Isthmus of Panama. In 1879 the 'International scientific congress,' as it was called, at Paris, under the auspices of M. Ferdinand de Lesseps, decided to recommend the construction of a ship canal at the Isthmus of Panama, to be built without locks and as an open cut from ocean to ocean. Those American delegates to the congress who were well fitted to judge of the facts from personal examinations, or reports of surveys at Darien, Tehuantepec, Panama, and Nicaragua, and other delegates qualified by practical experience, opposed in vain this decision, pointing out the difficulties and uncertain quantities which rendered a wise judgment and a reliable estimate impossible at that time, and urging the advantages of other sites. The enterprise, however, was to be carried on by Frenchmen; the assistance of M. de Lesseps was assured; and his success in carrying through the Suez canal, a far different undertaking in character of materials and obstacles to be overcome, was pointed to as an answer to all objections. The intention appeared to be to forestall any work which others might undertake at points which have been and still are regarded as much more favorable.

The canal congress estimated the cost of a sea-level canal at 700,000,000 francs, or £28,000,000, although a sub-committee had practically put the cost at 1,040,000,000 francs, and added that the "execution of such works, and principally that of such deep cuts, the stability of which is problematical, as well as the operations relating to the course of the river Chagres, constitute a complication of difficulties that it is impossible to estimate." There was added to the prime cost 25 per cent for unforeseen expenses, 5 per cent for expenses of banking and administration, and 3 per cent per year for interest during construction. An 'international commission' visited the isthmus in 1880, and reported that the canal would cost 843,000,000 francs, without preliminary, banking, and administrative expenses, and interest during construction, and estimating contingencies at but 10 per cent. They reported 75,000,000 cubic metres to be excavated, in place of 46,000,000 previously estimated. This estimate of cost M. de Lesseps first cut down to 658,000,000 francs, and later to 580,000,000 francs. A more extended acquaintance with the problem has raised the estimate of quantity to 125,000,000 cubic metres.

The dredging through the low alluvial lands near the sea, and the formation of harbor works, would, of course, present no difficulty; but the two rock-cuttings — the deepest at the Culebra, 820 feet in width at the top, containing from 25,000,000 to 30,000,000 cubic metres, of which but a small portion has yet been removed; and the Emperador cut, not so deep, but containing about the same quantity of rock — are very formidable obstacles, which will, at the rate work has as yet progressed, require many years to overcome. There is also the uncertainty whether little or much water will be encountered in the lower portions of these cuts. The removal of rock under water will swell the cost greatly.

[1] *The Panama canal: its history, its political aspects, and financial difficulties.* By J. C. RODRIGUES. New York, *Scribner*, 1885.

The Rio Grande and Rio Obispo cross the canal eleven and seventeen times respectively, and hence must be diverted, calling for thirty miles of new channels. The most formidable obstacle, however, and one which leads many engineers to doubt the possibility of the maintenance, if not the construction, of the canal, is the controlling of the tremendous floods of the upper Chagres, — a stream which, in the dry season, has a depth of but two feet, but which, in the rainy season, becomes a raging mountain torrent, rising sometimes in a few hours to a height of forty feet, and sweeping down immense quantities of *débris*. The projected line of the canal is first crossed by it at Gamboa, at an elevation of about fifty feet above the bottom of the canal; from Gamboa to the sea the canal is crossed by it twenty-nine times. It is evident that some most substantial and expensive works are needed to restrain or divert the flood waters of the Chagres, or the canal will be ruined by its irruption. An immense dam of masonry or earth, or of both materials, has been proposed, near Gamboa, a mile in length and from 150 to 200 feet high at its highest point, to impound and store up the flood in an artificial lake, from which it shall escape more gradually through sluices and channels provided for the purpose. The storage capacity of this reservoir is estimated at 6,000,000,000 cubic metres, which is not too much for a watershed on which a depth of five and one-half inches of rain has been known to fall in four and one-half hours. The occurrence of a second tropical rain, before the first has had time to drain away, might be disastrous. This difficult problem, which was pointed out and dwelt upon by some of the delegates to the congress, but was apparently passed lightly over by the majority, seems still to be unsolved at the hands of the French engineers, although the completion of its study has been promised from year to year.

The Panama railroad was purchased by the canal company; dwellings, hospitals, and workshops were erected; dredges, machinery, and tools were procured; and excavating was begun. Considerable earth and some rock have been removed. Rapid progress has been promised from time to time, but has not been attained; 2,000,000 cubic metres per month were hoped for, but 800,000 cubic metres have not been removed in any one month, and from 1881 up to May, 1885, the amount was only 12,376,000 cubic metres. The amount of material to be moved was first placed at 46,000,000 cubic metres, then 75,000,000 cubic metres, has now swelled to 125,000,000 cubic metres, and good judges believe this quantity to be much too low. M. de Lesseps has raised amounts as follows: 50 per cent on the shares of the company, 147,500,000 francs; loan of 1882, 125,000,000 francs; loan of 1883, 300,000,000 francs; and loan of 1884, 193,692,500 francs; making, in all, 766,192,500 francs. He has now applied to the French government for permission to issue new canal bonds to the amount of 600,000,000 francs, and proposes to call to his aid a lottery. A further call on the shareholders is also to be made. Discount and interest charges will amount to a formidable sum. One observer puts the time required to finish the canal at six years, another at twelve, and still others at twenty and even fifty years. Mr. Rodrigues fortifies his statements by citations from official documents, and from reports of U. S. officers and others, who have repeatedly inspected the progress of the work. He does not hesitate to predict the failure and bankruptcy of the present company within a short time.

The author devotes considerable space to the political aspects of the question, the stand which the United States has taken in the matter, the Monroe doctrine and the Clayton-Bulwer treaty, and the serious complications which may ensue if the French government shall take up officially the enterprise upon the failure of the canal company. The chapters given to the discussion of these topics are of great interest; but space will not allow a review of them here, even if it was appropriate for these pages.

HYPNOTISM.

Psychology is the last of the sciences to pass from the popular and literary stage to the technical. Time was when physics and chemistry were discovering facts of so flagrant and fundamental a nature, that fine ladies could be startled and entertained by accounts of them at dinner-parties. We have seen, in the last decade, biology present, in the Darwinian theory, what probably will be its last popularly interesting conception, and then plunge into such a labyrinth of embryological and other technicalities as only dry specialists can tread with her. Psychology even now trembles on the brink. Some departments are already quite intractable to literary handling; space perception, the measurements of various discriminations, and those of the time required by elementary mental processes, for example. But still much remains in psychology for the amateur of our generation to enjoy, and it is not yet impossible for treatises with some literary flavor to be written in that science. But the time is short; we seem on the verge of fundamental discoveries, and when they are made we must bid adieu to the simple charm, the easily verified facts. Work will be carried on

in a thicket in whose darkness only technically trained eyes will feel at home.

Hypnotism now stands where gravitation, galvanism, and the 'metamorphosis of plants' once stood. In France, especially, a real *fureur* of investigation is going on, and all sorts of people are trying their hand as magnetizers or as subjects. Repeatedly assailing the academies for recognition, as repeatedly rejected by reporting committees, whose criticism occupied itself too much with a few exceptional claims, and too little with the fundamental conditions of the hypnotic state, this latter at last wears official robes; and it is as 'bad form' now to be ignorant of its phenomena as a while ago it was to know any thing about them. To those who would no longer remain ignorant, Dr. Cullerre's little compilation[1] may cordially be recommended as the work of one who has tried to survey the whole ground, and who has certainly brought a great deal of scattered material together, and put it into readable shape. There is no other account of the subject at once so short and so complete. More than this we need not say of the book, for it makes no pretensions to originality, and the author's own critical comments are so rare, that a certain intellectual commonness about them may well be overlooked.

As matters now stand, the fundamental phenomena, sleep, narrowing of the field of consciousness, blotting out of memory, insensibility or hyperæsthesia, modifications of neuro-muscular irritability, hallucination in obedience to suggestion, etc., etc., are too *banals* to excite any longer much interest; and the attention of investigators is directed more and more to the *curiosities* of the hypnotic state, to those exceptional phenomena belonging to the individual subjects from which (by virtue of the law that nature shows us her secrets most readily in her monstrosities) most may be hoped for in the way of light thrown upon what is, after all, a great mystery.

Foremost among these novelties are the 'post-hypnotic impulsions,' which may take place weeks, or even months, after the patient has been hypnotized, in obedience to suggestions made during the trance; of which suggestions themselves nothing is remembered, the patient usually assigning for the act he finds himself irresistibly driven to perform, some pretext trumped up at the moment. It is obvious what power this gives to any unscrupulous operator who might wish to use his subjects as cat's-paws to crime. The remedy on the subject's part, if once he mistrusts the operator, would seem to be to get himself hypnotized by some other person, who, by suggesting that the former operator's proceedings should thenceforward be ineffectual, would in many cases actually render them so.

These inhibitions of certain processes by *negative suggestion* are among the greatest curiosities of hypnotism, and bid fair to put us on the track of important psychological secrets by isolating phenomena which usually are found combined. We may make a patient blind or deaf to special objects, and to nothing else, just as we may make him blind of one eye, deaf of one ear, or insensible to pain in one part of the body, — all by verbal suggestion that he shall become so. And the distinction that psychology makes between the mere *sensation* we receive from a thing, and the mental apperception or assimilation of the latter, so as to form a *percept*, is beautifully brought out in these experiments. For it seems that in them the blindness or other peculiarity is not the lack of sensation. A patient, for example, made to look at a red wafer on a sheet of paper, but told that there is nothing there, will not see the wafer — will say that the entire field of view is white. As soon, however, as the wafer is blown away, he will say he sees a green spot, its negative after-image. So a patient made blind to a particular by-stander cannot be made to see *him*. But how can the patient know *which one* to be blind to, without in some way discerning him? Some sort of a sensation of him must be there, or he would not be so singled out for invisibility.

The 'hemi-hypnotic' phenomena again afford a sort of moral vivisection of the patient into two halves. One side of the body may be cataleptic or lethargic, the other awake. One side of the face may be made to laugh, the other to weep. "If, in the hands of an open-eyed cataleptic subject, her knitting-work is placed, she takes it, and works away with remarkable skill. If the operator then close one of her eyes, the hand on the corresponding side falls inert, and the other hand continues all alone to perform the knitting movements, which, of course, then produce no effect." M. Richer describes a similar transformation of the act of washing the hands, into a unilateral operation. MM. Binet and Féré in some papers in the *Revue philosophique*, too late apparently to be noticed in Dr. Cullerre's book, have described most wonderful transferrences of the unilateral phenomena from one side to the other of the patient, whenever a magnet was brought near her, even without her knowledge. Many parts of their account are so startling that more verification is highly to be desired.

[1] *Magnétisme et hypnotisme.* Exposé des phenomènes observés pendant le sommeil nerveux provoqué. Par le Dr. A. CULLERRE. Paris, *Baillière*, 1886 [1885]. 16°.

Still more startling things are reported by MM. Bourreau and Burot of Rochefort, being nothing less than 'stigmatization' by suggestion, in a certain patient, i.e., the bleeding of spots of the skin at word of command. They have also seen, and convinced others, that this patient and one other, were influenced by medicines *in closed vials held near them*, salivated and sweated by Jaborandi, vomited by ipecac, purged by scammony, put to sleep by opium, etc. In these experiments the subjects were not hypnotized. They remind one of observations published long ago by Dr. J. R. Buchanan, and republished last year in his work, 'Psychometry.' Thus miracles expelled by 'scientific good sense' clamor again for admission. In particular the limits of suggestion have not to be re-tested. The new results seem to point towards some effects that may be direct and physical, and not due to suggestion or expectation. We are as yet but on the threshold of the subject.

If one wishes to see what hopes for success the method may inspire, one should read the brilliant article of Mr. F. W. H. Myers, entitled 'The human personality,' in the *Fortnightly review* for November. As Mr. Myers there says, we hold the wand of Hermes, which we have not learned to wield.

S. E.

THE UTILIZATION OF BY-PRODUCTS IN CHARCOAL-BURNING.

In many processes for the conversion of crude materials there is much waste, which is likely to be remedied only when such materials become scarcer, and hence more costly. In producing charcoal for use in the iron manufacture, the wood is commonly burned simply for the sake of the charcoal itself; and brick, dome-shaped ovens are used, from which the smoke and other products driven off by the process of slow combustion pass freely into the air. But in some cases such of the products as are commercially valuable are saved, with results that render it surprising that more care is not usually taken to retrieve what is so often lost. The success which has been met with at Elk Rapids, Michigan, in saving and profitably utilizing the by-products of charcoal-burning, is worthy of imitation.

At this place is a blast-furnace, turning out some seventy tons of charcoal-iron daily, and consuming the charcoal from one hundred and twenty-five cords of wood, previously carbonized in thirty-five kilns. The smoke and vapors given off in the latter process are drawn — by means of two exhaust-fans three feet in diameter, and making twelve hundred revolutions per minute — through the bottom of the kilns, and thence through a long wooden pipe forty-two inches in diameter, to the chemical works. Here the vapors are distributed to ten condensers, each containing seventy-five copper tubes two and a fourth inches in diameter, through which cold water is passed. So much of the vapor as is condensed is then drawn off into a large settling-tank: the uncondensed part is forced under the boilers by steam-injectors and burned, thus helping to furnish the motive power required at the works. In the tank the larger part of the tar settles to the bottom. This tar is now mixed with sawdust, and burned under the boilers; although formerly, when more in demand, it was drawn off and barrelled for market.

The remaining liquor is pumped to a second tank, and neutralized with lime. After the impurities have had time to settle, it is conveyed to a still, where the wood alcohol is distilled from the acetate of lime just produced. The liquor of acetate of lime is next evaporated by steam-heat nearly to the granulating point, then conveyed to grainers, and, by the further application of steam, it is obtained in the solid state. Finally it is shovelled out, drained, dried in pans, and put up in bags as the acetate of lime of commerce. The capacity of the works is 10,000 pounds of acetate of lime per day.

The alcohol, on issuing from the still, has a strength of eight per cent; but further distillation brings it to eighty-five per cent, when it is barrelled for shipment. It is, however, again refined by other parties to ninety-five per cent alcohol, and used for various mechanical purposes. The daily production can reach one hundred and seventy gallons.

An experiment has recently been tried at the London inventions exhibition aquarium, by Mr. W. August Carter, with a view to discovering how far fish are prone to sleep. After close examination, he found that among fresh-water fish the roach, dace, gudgeon, carp, tench, minnow, and catfish sleep periodically in common with terrestrial animals. The same instincts were found to actuate marine fish, of which the following were observed to be equally influenced by somnolence; viz., the wrasse, conger eel, dory, dogfish, wrasse bass, and all species of flat fish. Mr. Carter states, that, so far as he can discover, the goldfish, pike, and angler-fish never sleep, but rest periodically. Desire for sleep among fish varies according to meteorological conditions. Fish do not necessarily select night-time for repose.